

Computer Program Copy-Verify and Load Check System

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The Computer Program Copy-Verify and Load Check System consists of two programs, DOI-5352-SP and DOI-5379-SP. The system assures the integrity of a DSN program tape at two critical points—reproduction and loading. The Mag Tape Copy Routine DOI-5352-SP verifies the tape as it is being copied. The Mag Tape Load Check Loader Program interacts with parts of the Mag Tape Copy Routine to check the validity of a load in progress.

I. Introduction

Some DSN computer programs have presented a problem to the DSN Program Library because there is no direct way of reproducing their tapes. These programs are those which occupy almost all of the 16K memory locations in the XDS 920 computers; they are too large to be copied by a standard mag tape copy routine. This constraint also precludes the verification of a copied tape. The loading of these programs has also posed a problem because most of them are mission-critical real-time programs in which an unrevealed loading error could cause data loss or command malfunction. Procedures were needed to ensure that such tapes were copied accurately and loaded correctly.

The usual procedure for making mag tape copies was to incorporate a self-dump routine in the program itself; this routine dumped all of core memory as a single record on tape. The program was loaded into memory, and then a

branch was made to the self-dump routine. The routine allowed the program to be dumped as many as nine times, but there was no way of checking that the dump was correct or even whether the program was loaded accurately in the first place.

A reload routine was also incorporated in the program so that another record could be loaded in the event of a bad load or subsequent failure. The capability of reloading the program from the extra records on tape provided some insurance against bad recordings and stretching or other physical damage. However, this insurance did not prevent loss of data from program hangups and other failures, many of which were blamed on "bad loads" for want of a definite cause, although they could have stemmed from copy errors or loading errors.

From the point of view of the DSN Program Library, the procedure is unsatisfactory. The Program Library is

charged with the responsibility for the accurate duplication of mag tapes, and this procedure does not ensure accuracy. The self-dump technique provides a means of making copies of a tape, but, except for parity checking in the computer and tape units, it does not verify that the copies are 100% accurate. To ensure accurate duplication, 100% verification is considered necessary.

The self-dump routine was therefore rewritten to include a verification sequence; the new program is titled Mag Tape Copy Routine DOI-5352-SP and has been distributed to personnel engaged in programming for the Deep Space Network XDS 920 computers. The program occupies 400_s locations in memory starting at location 36000_s. The program dumps core into mag tape as many times as requested, rewinds, and then performs a word-by-word comparison between core and the records on tape. Typewriter messages indicate successful verification or comparison errors; in the latter case, the whole procedure is restarted.

Mag Tape Copy Routine DOI-5352-SP also includes a load-check routine, which is used in conjunction with Mag Tape Load-Check Loader DOI-5379-SP to ensure a correct load. Following the load from mag tape, the program branches to the load-check routine, reads another record from tape, and compares it word by word with the record already loaded in core. Typewriter messages indicate whether or not the comparison (and, hence, the load) is successful. Together, these two programs comprise a system which ensures against copy errors and "bad loads."

II. Program Description

Mag Tape Copy Routine DOI-5352-SP, written in XDS 920 symbol language, is essentially in two parts: a dump sequence, in which a requested number of records is written on tape, and a verify sequence, in which the tape is compared word by word with core memory. The routine checks for buffer errors in the dump sequence and for comparison errors in the verify sequence. If a buffer error occurs, the tape erases backwards over the entire record, and then erases forward over half the record to get the tape quickly by any bad areas. Comparison errors are indicated by an error message; the tape rewinds to load point for another start.

No comparison is made of the area in which the copy routine is located (36000_s-36377_s). Since values are chang-

ing in these locations during the comparison sequence, the whole area is bypassed. Copy errors in this section would be inconsequential because tapes are ordinarily copied from a single master and not from other copies.

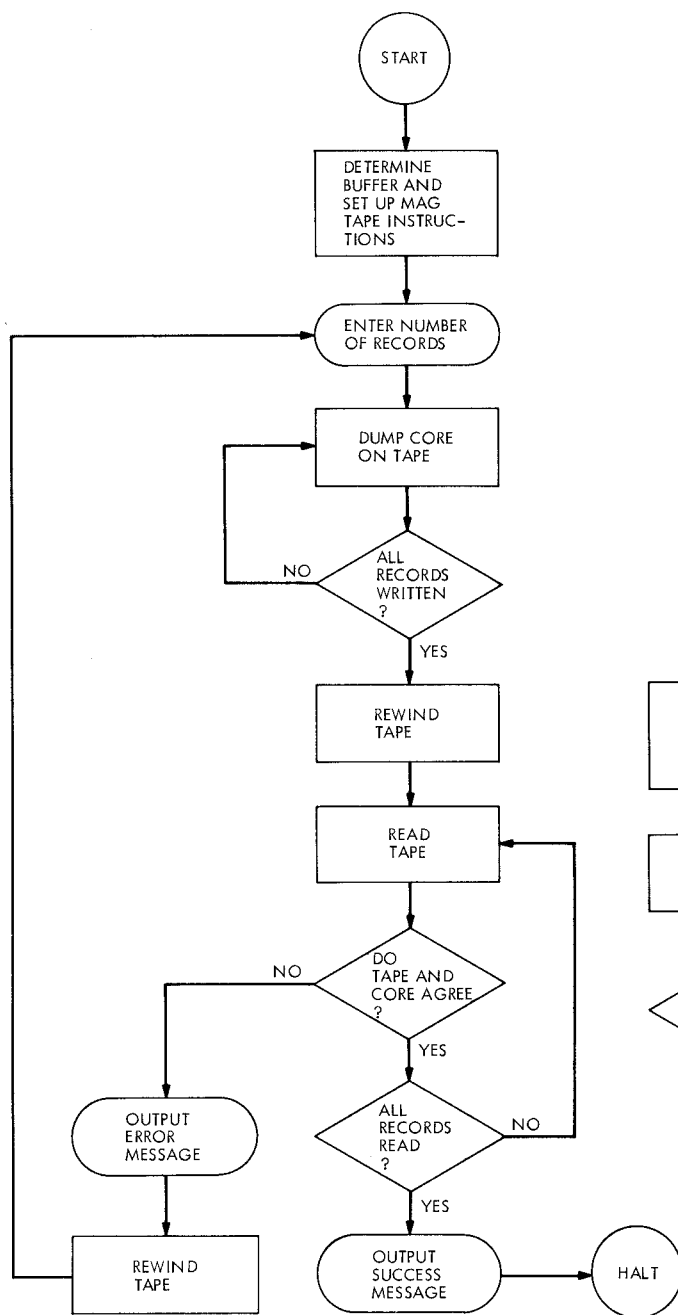
A feature of this program is that either buffer may be connected to the tape units; the program automatically determines which buffer is connected and sets up all the mag tape instructions accordingly. The buffer test is performed using the end-of-tape test as a pseudo-instruction. If the tape is not at the end of the reel, a W-buffer end-of-tape test will cause the next instruction to be executed provided the tape unit is connected to the Y-buffer, or it will cause the next instruction to be skipped if the tape unit is connected to the W-buffer.

The load-check routine is incorporated in this program and shares subroutines with the dump and verify sequences as needed. Mag Tape Load-Check Loader DOI-5379-SP branches to this routine after loading a program from mag tape. The load-check routine reads the next record from tape and compares it word by word with core memory. If the comparison is successful, a LOADCHECK OK message is typed out; if a comparison error is found, the operator is alerted with an error message and the program branches back to the loader to begin the operation again.

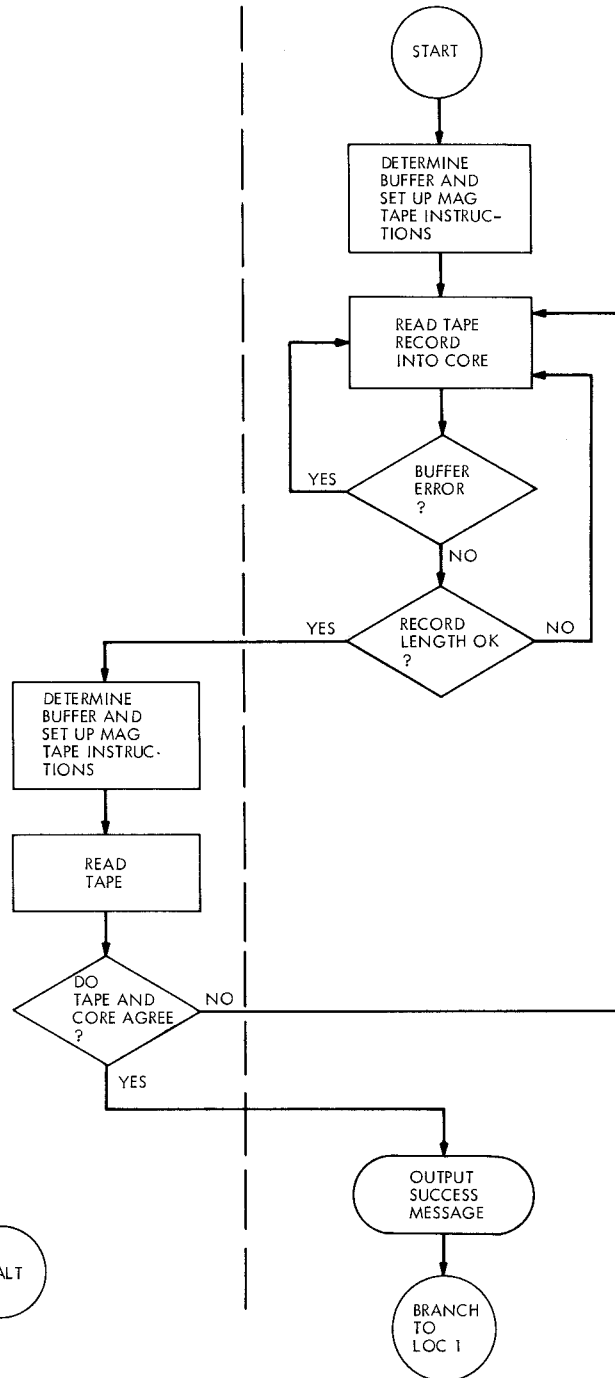
Some features of Mag Tape Load-Check Loader DOI-5379-SP are that it will operate with either buffer, it zeroes core memory before loading a program from mag tape, it rejects any record on tape that is shorter than normal and reads instead the next record, and it branches to location 1 (where it expects to find a branch to the beginning of the program) after loading and verifying that the proper load was achieved.

III. Conclusion

The success obtained with this copy-verify and load-check system indicates that it is a feasible and practical way of verifying tape duplication and loading. Its use by programmers is encouraged to provide the DSN Program Library with a convenient means of verifying that tapes are copied accurately and to provide Deep Space Stations with assurance that programs are loaded correctly. The next step is to expand the system to include those tapes which are recorded with subprograms following the main records and those which are recorded in modular form.



MAG TAPE COPY ROUTINE DOI-5352-SP



MAG TAPE LOAD CHECK LOADER DOI-5379-SP

Fig. 1. Routine sharing between programs